

## Claims

What is claimed is:

- 1           1.     A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array and a  
3 plurality of calendars for scheduling said flows, said scheduling method  
4 comprising the steps of:  
5           storing an active flow indicator for each calendar entry in a calendar  
6 status array (CSA);  
7           storing a subset of said active flow indicators from said calendar  
8 status array (CSA) in a cache; and  
9           updating calendar status array (CSA) based upon a predefined  
10 calendar range and resolution; and  
11           utilizing said subset of said active flow indicators to determine a flow  
12 of a calendar for servicing.
- 1           2.     A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array as recited  
3 in claim 1 wherein the step of storing said active flow indicator for each  
4 calendar entry in said calendar status array (CSA) includes the step of  
5 storing one bit for each calendar entry in said calendar status array (CSA).
- 1           3.     A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array as recited  
3 in claim 1 wherein the step of storing said active flow indicator for each  
4 calendar entry in said calendar status array (CSA) includes the step of  
5 storing said active flow indicator for each weighted fair queue (WFQ) ring  
6 entry in a calendar status array (CSA).

1           4.     A scheduling method for implementing Quality-of-Service  
2     (QoS) scheduling for a plurality of flows with a cached status array as recited  
3     in claim 1 wherein said cache includes a predefined number of bits for  
4     storing said cache copy subset for each of the calendars and wherein the  
5     step of storing said subset of said active flow indicators from said calendar  
6     status array (CSA) in a cache includes the step of utilizing a current pointer  
7     (CP) to a calendar entry and loading said subset of said active flow  
8     indicators from said calendar status array (CSA) starting at said current  
9     pointer (CP) CSA entry and increasing through said predefined number of  
10    CSA entries equal to said predefined number of bits.

1           5.     A scheduling method for implementing Quality-of-Service  
2     (QoS) scheduling for a plurality of flows with a cached status array as recited  
3     in claim 4 wherein the step of loading said subset of said active flow  
4     indicators from said calendar status array (CSA) includes the step of using  
5     said current pointer (CP) to determine one of plurality of addressed portions  
6     of said calendar status array (CSA) to be accessed.

1           6.     A scheduling method for implementing Quality-of-Service  
2     (QoS) scheduling for a plurality of flows with a cached status array as recited  
3     in claim 5 wherein said predefined number of bits for storing said subset for  
4     each of the calendars is thirty-two bits and wherein said calendar status  
5     array (CSA) includes four addressed portions of one hundred twenty-eight  
6     bits of said calendar status array (CSA), each said addressed portion  
7     accessible in one cycle.

1           7.     A scheduling method for implementing Quality-of-Service  
2     (QoS) scheduling for a plurality of flows with a cached status array as recited  
3     in claim 1 wherein the step of storing said active flow indicator for each  
4     calendar entry in said calendar status array (CSA) includes the step for each  
5     of said plurality of calendars of storing said active flow indicator for each  
6     calendar entry in said calendar status array (CSA).

1           8.     A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array as recited  
3 in claim 7 wherein said plurality of calendars include a low latency service  
4 (LLS) calendar, a normal latency service (NLS) calendar, and a peak  
5 bandwidth service (PBS) calendar and includes the step segmenting each of  
6 said plurality of calendars into epochs (0:p), where epoch 0 has a highest  
7 resolution and a lowest range; and epoch 1 through epoch p have a range of  
8  $n(p)$  times a range of epoch 0; and epoch 1 through epoch p have a  
9 resolution of  $1/n^{**p}$  times a resolution of epoch 0, where n is a scaling factor.

1           9.     A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array as recited  
3 in claim 8 wherein the step of updating said calendar status array (CSA)  
4 based upon a predefined calendar range and resolution includes the step of  
5 updating said calendar status array (CSA) based upon said predefined  
6 calendar range and resolution of said epoch 0 through said epoch p.

1           10.    A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array as recited  
3 in claim 8 wherein the step of updating said calendar status array (CSA)  
4 based upon said predefined calendar range and resolution of said epoch 0  
5 through said epoch p for said low latency service (LLS) calendar, said  
6 normal latency service (NLS) calendar, and said peak bandwidth service  
7 (PBS) calendar.

1           11.    A scheduling method for implementing Quality-of-Service  
2 (QoS) scheduling for a plurality of flows with a cached status array as recited  
3 in claim 1 includes the step of utilizing said subset of said active flow  
4 indicators for incrementing a current pointer (CP) by an identified number of  
5 positions up to a current time (CT) value, said identified number of positions  
6 equal to a variable number of inactive flow indicators up to said current time  
7 (CT) value and said identified number of positions having a maximum value  
8 equal to a number of entries in said cache.

1           12. A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows comprising:  
3 a queue manager;  
4 a plurality of calendars coupled to said queue manager for scheduling  
5 said flows,  
6 a calendar status array (CSA) coupled to said plurality of calendars  
7 for storing an active flow indicator for each calendar entry for each of said  
8 plurality of calendars;  
9 a cache coupled to calendar status array (CSA) for storing a cache  
10 copy subset of said active flow indicators from said calendar status array  
11 (CSA); and  
12 a calendar updating algorithm for updating calendar status array  
13 (CSA) based upon a predefined calendar range and resolution; and  
14 said queue manager for utilizing said cache copy subset of said active  
15 flow indicators to determine a flow of a calendar for servicing.

1           13. A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows as recited in claim 12 wherein plurality of  
3 calendars include a low latency service (LLS) calendar, a normal latency  
4 service (NLS) calendar, and a peak bandwidth service (PBS) calendar.

1           14. A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows as recited in claim 12 wherein said  
3 calendar updating algorithm for updating calendar status array (CSA) based  
4 upon a predefined calendar range and resolution includes segmenting each  
5 of said plurality of calendars into epochs (0:p), where epoch 0 has a highest  
6 resolution and a lowest range; and epoch 1 through epoch p have a range of  
7 n(p) times a range of epoch 0; and epoch 1 through epoch p have a  
8 resolution of  $1/n^{**p}$  times a resolution of epoch 0, where n is a scaling factor.

1           15. A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows as recited in claim 14 wherein said  
3 calendar updating algorithm for updating calendar status array (CSA) based  
4 upon a predefined calendar range and resolution is based upon a priority of  
5 said low latency service (LLS) calendar, said normal latency service (NLS)  
6 calendar, and said peak bandwidth service (PBS) calendar and a number of  
7 said epoch.

1           16.    A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows as recited in claim 14 wherein said  
3 calendar updating algorithm for updating calendar status array (CSA) based  
4 upon a predefined calendar range and resolution accesses said calendar  
5 status array (CSA) by an ascending order said epoch for each of said  
6 calendars in an order of said low latency service (LLS) calendar, said normal  
7 latency service (NLS) calendar, and said peak bandwidth service (PBS)  
8 calendar.

1           17.    A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows as recited in claim 14 includes a current  
3 pointer (CP) to determine one of a plurality of addressed portions of said  
4 calendar status array (CSA) to be accessed in a system cycle.

1           18.    A QoS scheduler for implementing Quality-of-Service (QoS)  
2 scheduling for a plurality of flows as recited in claim 14 includes current  
3 pointer (CP) incrementing means utilizing said cache copy subset of said  
4 active flow indicators for incrementing a current pointer (CP) by an identified  
5 number of positions up to a current time (CT) value, said identified number of  
6 positions equal to a variable number of inactive flow indicators up to said  
7 current time (CT) value and said identified number of positions having a  
8 maximum value equal to a number of entries in said cache.

- 1           19.    A computer program product for implementing Quality-of-  
2   Service (QoS) scheduling of a plurality of flows with a cached status array  
3   and a plurality of calendars for scheduling said flows in a scheduler, said  
4   computer program product including a plurality of computer executable  
5   instructions stored on a computer readable medium, wherein said  
6   instructions, when executed by said scheduler, cause said scheduler to  
7   perform the steps of:  
8           storing an active flow indicator for each calendar entry for each of said  
9   plurality of calendars in a calendar status array (CSA);  
10          storing a subset of said active flow indicators from said calendar  
11   status array (CSA) for each of said plurality of calendars in a cache; and  
12          updating calendar status array (CSA) based upon a predefined  
13   calendar range and resolution for each of said plurality of calendars; and  
14          utilizing said subset of said active flow indicators for each of said  
15   plurality of calendars to determine a flow of a calendar for servicing.
- 1           20.    A computer program product for implementing Quality-of-  
2   Service (QoS) scheduling of a plurality of flows with a cached status array  
3   and a plurality of calendars for scheduling said flows in a scheduler as  
4   recited in claim 19 wherein said instructions, when executed by said  
5   scheduler, cause said scheduler to perform the steps of utilizing said subset  
6   of said active flow indicators for incrementing a current pointer (CP) by an  
7   identified number of positions up to a current time (CT) value, said identified  
8   number of positions equal to a variable number of inactive flow indicators up  
9   to said current time (CT) value and said identified number of positions having  
10   a maximum value equal to a number of entries in said cache.